Technical Report 13-005

Learning Networks: Iran and the Effects of Sanctions

Louis Boguchwal
Marc Johnson
Lauren Kewley
Daniel Evans
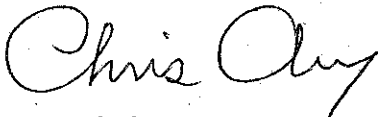

U.S. Military Academy, West Point NY

March 2013

United States Military Academy
Network Science Center

**U.S. Military Academy
Network Science Center**

Authorized and approved for distribution:

Chris Ary

BG (R) CHRIS ARNEY, Ph.D.
Network Science Chair

John M Graham

COL JOHN M GRAHAM, Ph.D.
Director, Network Science Center

Technical review by

William Pulleyblank, Ph.D., Department of Mathematical Sciences, U.S. Military
    Academy
Tish Torgerson, Network Science Center, U.S. Military Academy

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
27-03-2013	Technical Report	May 2012–Sept 2012

4. TITLE AND SUBTITLE

Learning Networks: Iran and the Effects of Sanctions

5a. CONTRACT NUMBER
n/a

5b. GRANT NUMBER
n/a

5c. PROGRAM ELEMENT NUMBER
n/a

6. AUTHOR(S)
Louis Boguchwal, Marc Johnson, Lauren Kewley, and Daniel Evans

5d. PROJECT NUMBER
ARO NetSci 03

5e. TASK NUMBER
n/a

5f. WORK UNIT NUMBER
n/a

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Network Science Center,
U.S. Military Academy
601 Cullum Road, Thayer Hall Room 119
West Point, NY 10996

8. PERFORMING ORGANIZATION REPORT NUMBER
n/a

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S.Army Research Office
Triangle Park, NC

10. SPONSOR/MONITOR'S ACRONYM(S)
USMA NSC

11. SPONSOR/MONITOR'S REPORT NUMBER(S) 13-005

12. DISTRIBUTION / AVAILABILITY STATEMENT

Unlimited Distribution

13. SUPPLEMENTARY NOTES
The views expressed in this thesis are those of the authors and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

14. ABSTRACT

Iranian government, financial, and business entities are adapting to, and learning from, each new round of international sanctions. When a sanction is imposed, agents and organizations, predictably, develop creative methods to bypass it in order to continue the pursuit of nuclear weapons production. Based on this scenario, can we quantitatively model the evolution and "learning" of this Iranian Network?

This was the question posed to three summer apprentices at the Network Science Center over the course of their internship during the summer of 2012. Based on team discussions, the group developed three possible methods to formulate and analyze this issue. These network-based techniques are introduced: standard network analysis, time series analysis, and network flows. This paper synthesizes and summarizes our research efforts.

15. SUBJECT TERMS
Network Science, Social Network Analysis, Dynamic Networks

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT UNCLASSIFIED	**b. ABSTRACT** UNCLASSIFIED	**c. THIS PAGE** UNCLASSIFIED	UL	6	Tish Torgerson

19b. TELEPHONE NUMBER *(include area code)*
845-938-0804

Learning Networks: Iran and the Effects of Sanctions

Louis Boguchwal
Marc Johnson
Lauren Kewley
Daniel Evans

U.S. Military Academy, West Point NY

ACKNOWLEDGEMENT

Learning Networks: Iran and the Effects of Sanctions
Louis Boguchwal, Marc Johnson, Lauren Kewley, and Daniel Evans

Background

Iranian government, financial, and business entities are adapting to, and learning from, each new round of international sanctions. When a sanction is imposed, agents and organizations, predictably, develop creative methods to bypass it in order to continue the pursuit of nuclear weapons production. Based on this scenario, can we quantitatively model the evolution and "learning" of this Iranian Network?
This was the question posed to three summer apprentices at the Network Science Center over the course of their internship during the summer of 2012. Based on team discussions, the group developed three possible methods to formulate and analyze this issue. These network-based techniques are introduced: standard network analysis, time series analysis, and network flows. This paper synthesizes and summarizes our research efforts.

Introduction

As Iran continues to bolster its nuclear program, policymakers around the world ponder their responses. Since 2005, the United Nations, European Union, and United States have issued several hundred sanctions on both organizations and individuals (Iran Watch, 2012). However, there is great debate as to whether these sanctions are effective in curbing Iran's nuclear arms efforts. To manage global nuclear fears, it is necessary to understand the political and socioeconomic scenes in Iran.

Political and Socioeconomic Overview

In 1979, the Iranian monarchy was overthrown and Ayatollah Khomeini came to power and was declared the "Supreme Leader." (CIA World Factbook). The present government consists of both elected and unelected institutions, which ultimately form executive, legislative, and judicial branches of government. A visual representation of the governmental structure can be found in Figure 1, below (BBC News). The Supreme Leader holds immense political power, whereas the President holds relatively little. The Supreme Leader, rather than the President, controls the armed forces and makes policy decisions regarding security and defense. While the President is technically elected, he

must pass the vetting process of the Guardian Council in order to run for office (BBC News).
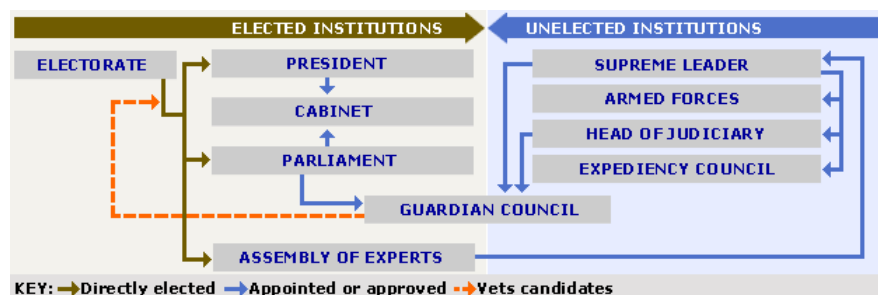

Figure 1: Diagram of the post-revolution governmental structure in Iran, courtesy of BBC News.

The dominant military force in Iran is the Islamic Revolutionary Guard Corps (IRGC)[1], a special military organization consisting of politically loyal and religiously devout personnel. The IRGC was instrumental in the success of the Iranian Revolution, and exists to this day to protect the power of the Supreme Leader from foreign or domestic threats (CIA World Factbook). It is approximately 125,000 strong and boasts its own ground force, navy, and air force. Further, the IRGC manages Iran's strategic weapons. The Guards' engineering arm, Khatam-al Anbia, receives hundreds of government contracts and is thought to have billions of dollars in assets (BBC News). To underscore this economic dominion, the IRGC has a massive stake in numerous industries, ranging from agriculture, to automotives, to tourism (Wehrey et .al. – RAND, 2009). Finally, the IRGC receives additional funding through its control of Bonyads, Iranian charitable trusts that are government subsidized consortiums involved in an amazing array of diverse businesses. This structure also gives these Bonyads the ability to secretly fund nuclear development or terrorist activities. For example, the assets of the Mostazafan Bonyad alone are estimated to exceed $10 billion (Klebnikov, 2003). Thus, it is not surprising that many IRGC personnel have risen to prominent positions throughout the Iranian government. Taken together, the IRGC controls approximately 33%-40% of the Iranian economy (Katzman, 2006). Consequently, leaders of the organization and the organization as a whole are points of interest when working to hinder Iranian nuclear arms production. Preliminary network analysis will help identify additional entities for investigation.

Sanctions Issued by the UN, EU, and US

United Nations, European Union, and United States fear of the development of an Iranian nuclear arms capability has resulted in the issuance of several hundred sanctions to both individuals and organizations associated with the nuclear program

---

[1] Also known as Pasdaran.

(Iran Watch, 2012). However, it remains to be seen as to whether these sanctions merely harm ordinary Iranian citizens, or actually impact nuclear weapon development. Iran's diverse economic structure, including its numerous sectors and Bonyads, potentially allow it to avoid the worst of any potential sanction effects.

Dr. Reza Aslan, of the Islamic Studies Department of the University of California, Riverside, believes that sanctions could prove to be counterproductive. Economic pressure on the Iranian economy could foster even greater reliance on black market activities, which are largely controlled by the Revolutionary Guard, the very organization that oversees Iran's strategic weapons. Also, the resulting insular foreign policy enables the Supreme Leader and the IRGC to consolidate power and influence. Aslan contends that if Iran wants nuclear weapons, it will have them. He believes that sanctions have been entirely ineffective and that a more promising solution would be to coerce Iran into making political and economic reforms (Aslan, 2010).

Similar to Aslan, Dr. Hassan Hakimian, of the London Middle East Institute, also believes that sanctions have not been, and will never be, effective in curbing Iran's nuclear efforts. He claims that Iran has expected sanctions for quite some time, allowing it to prepare for their arrival and avoid the most severe economic consequences. While sanctions exacerbate existing economic hardships in Iran, namely unemployment and inflation, such hardships only affect ordinary citizens. The elite, such as Revolutionary Guard personnel, remain unscathed. Change by internal pressure is not practical, as the IRGC would crush any efforts made by citizens to influence government policy in response to sanction hardship. Finally, Hakimian argues that sanctions may be ineffective for two reasons: false rationality assumptions and ideological beliefs. Sanctions rely upon a rational policy process in which policy-makers respond to dynamically-changing costs and benefits of a particular policy. This process is likely not rational. Next, Iran's ideologically-driven nature may allow it to tolerate sanctions for a long time (Hakimian, 2012).

In developing methods to curb Iranian nuclear arms proliferation, we seek to answer the following questions:

1. Are the sanctions currently in place effective in hindering nuclear arms production in Iran?
2. If current sanctions are ineffective, do there exist alternative, strategic sanctions that would in fact be more favorable?
3. What connections and associations must be disrupted in order to hinder nuclear arms production? Given this analysis, what form of action is necessary to implement these analytical solutions?

To answer these questions, we will apply three methods of network analysis: standard network analysis, time series analysis, and network flows. These approaches are summarized below and will be discussed in additional detail in three additional papers.

Standard Network Analysis

Standard network analysis methods attempt to identify the key actors in a given process. For example, a "central" individual might be one who knows many others. Standard network analysis is both structural and static. A node, or entity, is categorized as important based upon the structure of the network exclusively. That is, the known relationships and associations that comprise a network dictate who is deemed to be most important. These methods are only as accurate as the network at the time it was constructed. The network under consideration in this framework is time-invariant. Put another way, the connections and associations are fixed for any window of time.

Time Series Analysis

Time series analysis differs from standard network analysis methods in that the framework is dynamic. Where the connections in the network discussed in Standard Network Analysis were fixed, now changes in network structure are observed as time progresses. The network under consideration is time-variant. Ultimately, we will compare the network's structure and its corresponding centrality measures over time. Centrality measures are numerical representations of various attributes of an individual node. For example, if our time step is one year, we would compare the attributes of the 2005 network to the 2006 network. These comparisons lend themselves to sensitivity analyses of the various measures. Thus, we can evaluate changes to the network in response to sanctions over time.

Network Flows

Network flow algorithms are part of the broader field of network optimization. Under this framework, a network is viewed as an amalgamation of routes in which a resource could travel along. A network will be constructed for each resource, e.g. funds, in which two entities are connected if the resource was transferred from one to the other. This framework allows us to analyze and track the movement of resources necessary for nuclear arms production. Nodes are classified into three types: supply nodes, demand nodes, and intermediaries. Supply nodes provide the resource to other entities within the network. They serve as points of origination for the resource. Demand nodes are the final recipients of the commodity. Finally, intermediaries enable transmission resources through the network. The application of network flow algorithms provides

insight into which connections or entities should be disrupted in order to prevent a resource from reaching demanders. Note that arbitrarily eliminating numerous connections or entities could achieve the same result, but the solution that we seek involves minimal policy intervention. Thus, if resources cannot reach their destinations, production processes cannot operate efficiently, or at peak levels. Observe that while these methods analytically determine short-term optimal policy goals, they do not inherently provide recommendations as to how these policies should be implemented or enforced.

Conclusion

The team has developed three separate approaches that we believe can effectively address the question of the effectiveness of sanctions from a network analysis perspective. Each of these approaches will be addressed in detail in papers that are to be published by the Network Science Center at West Point. These papers will be conceptual in nature due to the lack of available and accurate data concerning the Iranian Nuclear Development Network. We believe that the development of an effective methodology is possible without the actual data and, upon acquisition of the relevant data, an analyst can apply the developed methodology in order to conduct a rigorous network analysis.

References

BBC News. "Iran - Who Holds the Power?" BBC News. BBC.
http://news.bbc.co.uk/2/shared/spl/hi/middle_east/03/iran_power/html/default.stm

BBC News. "Profile: Iran's Revolutionary Guards." BBC News. BBC, 18 Oct.
2009. http://news.bbc.co.uk/2/hi/middle_east/7064353.stm.

Central Intelligence Agency. "CIA World Factbook - Iran." CIA. Central Intelligence
Agency, 30 July 2012. https://www.cia.gov/library/publications/the-world-factbook/geos/ir.html.

Hakimian, Hassan (Guest). "How Sanctions Affect Iran's Economy." Interview by Toni
Johnson. How Sanctions Affect Iran's Economy. Council on Foreign Relations,
23 May 2012. Web. http://www.cfr.org/iran/sanctions-affect-irans-economy/p28329.

Katzman, Kenneth. "Iran's Bonyads: Economic Strengths and Weaknesses." Emirates Center for Strategic Studies and Research, 6 Aug. 2006. Web. http://www.ecssr.com/ECSSR/appmanager/portal/ecssr?_nfpb=true.

Klebnikov, Paul. "Millionaire Mullahs." Forbes. Forbes Magazine, 21 July 2003. Web. http://www.forbes.com/forbes/2003/0721/056_3.html.

Reza Aslan. (Guest). "Iran scholar doubts effectiveness of sanctions" [Radio series episode]. Interview by Guy Raz. Iran Scholar Doubts Effectiveness of Sanctions. National Public Radio, 12 June 2010. Web. http://www.npr.org/templates/story/story.php?storyId=127799038

Wehrey, Frederic M.; Green, Jerrold; Nichiporuk, Brian, Nadar, Alireza; Hansell, Lydia; Nafisi, Rasool; and Bohandy, S.R. The Rise of the Pasdaran: Assessing the Domestic Roles of Iran's Islamic Revolutionary Guards Corps. Santa Monica, CA: RAND National Defense Research Institute, 2009. Print.

Wisconsin Project on Nuclear Arms Control, Iran Watch. (2012, May 09). Tracking the world's efforts to punish entities supporting proliferation in iran. Retrieved from http://www.iranwatch.org/ourpubs/bulletin/unscmatrix.htm